

# Transvenous Embolization of Primitive Trigeminal Artery Variant-Cavernous Fistula with Guglielmi Detachable Coils

## A Case Report

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### Summary

*Here, we present a 32-year-old male with proptosis and chemosis of the left eye following a close head injury. Digital subtraction angiography of the left internal carotid artery showed a left carotid-cavernous fistula (CCF) associated with a primitive trigeminal artery (PTA) variant. The patient was successfully treated with transvenous Guglielmi detachable coils embolization via the inferior petrosal sinus.*

*The PTA variant was preserved without cerebellar or brainstem infarct.*

### Introduction

A primitive trigeminal artery (PTA) variant is defined as a cerebellar artery with anomalous origin from the internal carotid artery near the trigeminal site but without connection with the vertebro-basilar system. PTA variants are associated increased incidences of coexisting intracranial vascular abnormalities, and most of these abnormalities are reported to be intracranial aneurysms within the circle of Willis. Here, we report the first case of a PTA variant-carotid fistula that was successfully treated endovascularly.

### Case Report

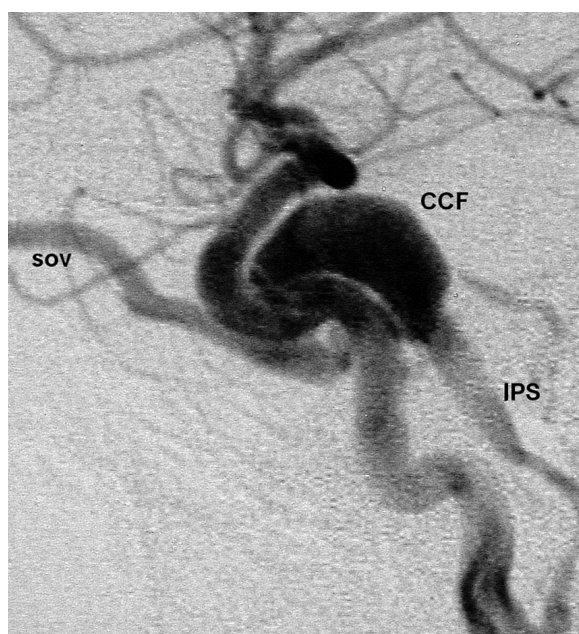
A 32-year-old male experienced a close head injury and was sent to the emergency room of

our institution. At that time, non-enhanced brain CT imaging showed no intracranial hemorrhaging and no calvarial or skull base fracture. Two days later, the patient developed proptosis and chemosis of the left eye. He underwent cerebral digital subtraction angiography (DSA) for clinical suspicion of traumatic carotid-cavernous fistula (CCF).

During injection into the left internal carotid artery (ICA) there was early opacification of the engorged left cavernous sinus (Figure 1), consistent with a CCF, which was drained via the enlarged left superior ophthalmic vein (SOV) and inferior petrosal sinus (IPS). An unusual vessel, which was more clearly observed in the earlier phase of the left ICA angiogram (Figure 2), departed from the ICA just below the posterior genu. The vessel traveled posteriorly for a short distance and then curved upward, carrying flow into the infero-posterior aspect of the left cavernous sinus. Thereafter, the vessel ran inferolaterally, following the expected course of the left inferior cerebellar artery (AICA).

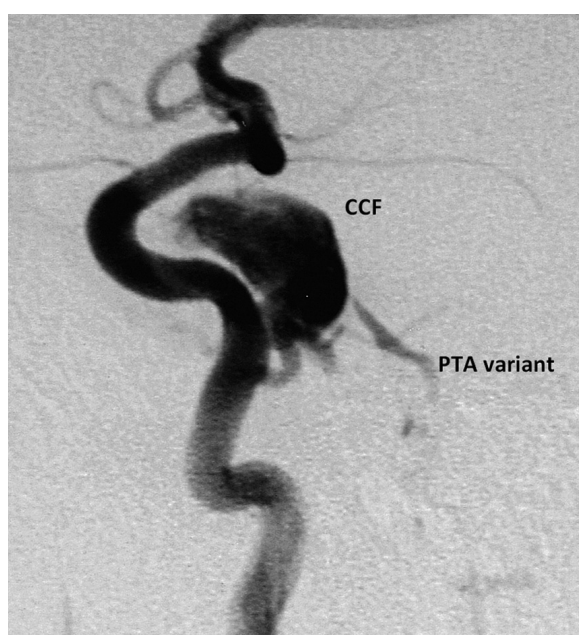
Selective injection of the bilateral vertebral arteries showed no opacification of the left AICA. By definition, this vessel was a PTA variant, and a traumatic PTA variant-cavernous fistula was diagnosed.

The patient was treated by transvenous coil embolization using Guglielmi detachable coils (GDC). Through left femoral artery and right femoral vein punctures, we selected the left



*Figure 1* Left ICA injection, lateral projection, showed CCF drained by the ophthalmic vein and the inferior petrosal sinus.

ICA with a 5.5 Fr headhunter catheter and accessed the left cavernous sinus via the left IPS with a coaxial microcatheter system. GDC deployment began in the anterior left cavernous



*Figure 2* Earlier phase of left ICA injection, lateral projection, demonstrated an unusual vessel arising from presellar segment of the ICA and contributing to CCF.

sinus, near the junction with the left SOV, and proceeded posteriorly. During GDC deployment, the left ICA was repeatedly injected to determine the luminal patency of the cavernous segment of the left ICA and the PTA variant. The left cavernous sinus was almost completely embolized, and both the ICA and PTA variant flow was preserved (Figure 3 A, B).

The patient's symptoms subsided following successful endovascular treatment of the PTA variant-cavernous fistula. No focal neurological deficit occurred. Follow-up magnetic resonance imaging one year later showed patent flow of the PTA variant and no evidence of fistula recurrence.

## Discussion

In the human embryo at 3-mm long, the PTA ensures nutrition of the hindbrain and mid-brain by connecting the ICA with longitudinal neural arteries, which later become the basilar artery. As the posterior communicating artery develops, the PTA regresses and normally disappears by the 14-mm stage.

When PTA persists, as seen in approximately 0.3% of cerebral angiograms, it extends from the presellar segment of the internal carotid artery to the basilar system.

This is termed a PTA variant if a single cerebellar artery arises from the trigeminal site without connecting to the basilar artery. Siqueira et Al (1993) reported the incidence of PTA variants to be 0.18% from a cohort of 5500 patient who underwent angiography<sup>1</sup>. Haughton et Al (1978) proposed that failure of longitudinal neural arteries to completely fuse with the PTA accounted for the development of a PTA variant<sup>2</sup>.

The PTA variant can be isolated, and it may be asymptomatic, co-occur with intracranial aneurysm, or in rare cases be associated with trigeminal neuralgia<sup>3</sup>.

In 2000, Hanabusa et Al reviewed 45 cases of PTA variant<sup>4</sup>, and in 2001, Nishio et Al reviewed 67 cases<sup>5</sup>. These studies found that approximately 70% of PTA variants had AICA as the terminal branch, and the remaining 30% of PTA variants connected with either the superior cerebellar artery or the posterior inferior cerebellar artery. Aneurysms occurred on 22 occasions, in 15 of the 67 cases of PTA variant, and the majority of these aneurysms occurred in the circle of Willis.

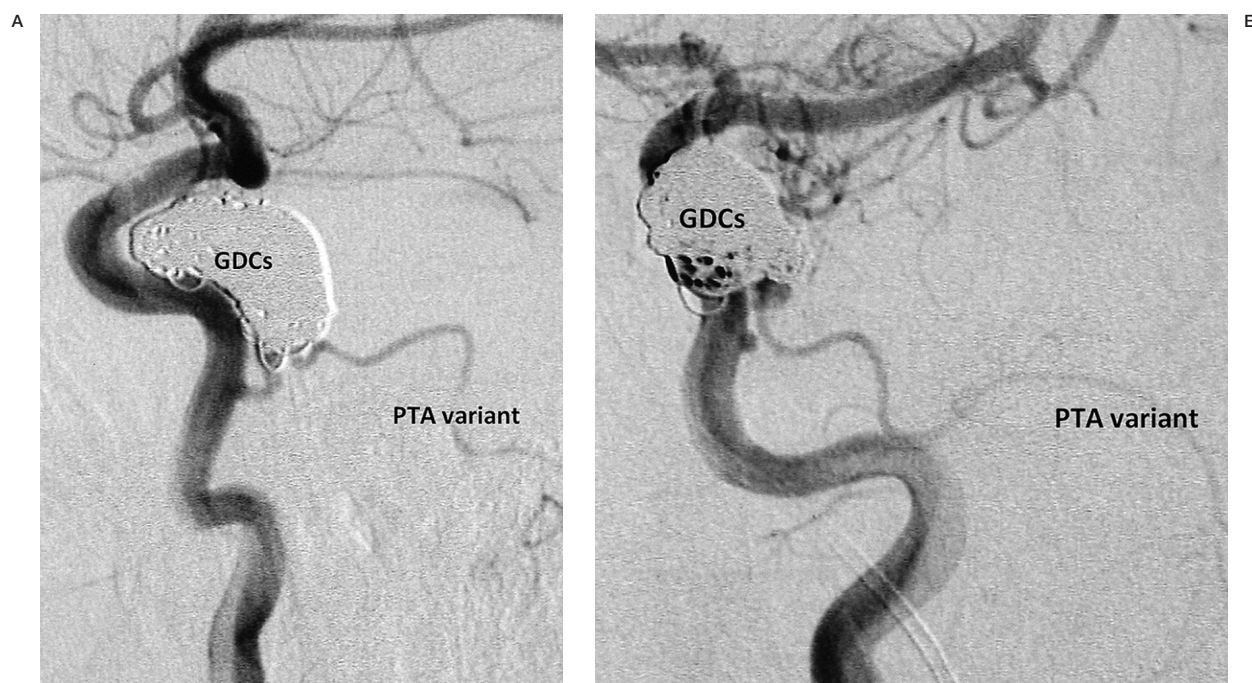


Figure 3: A,B) Left ICA injection, AP & lateral projection, demonstrated preserved flow of ICA and PTA variant after GDCs embolization of CCF.

Only 4 aneurysms arose from the junction of the ICA and PTA variant, and in 1 case the aneurysm was localized to the distal portion of the PTA variant trunk. In the current case, the PTA variant-cavernous fistula developed following close head injury.

Several factors may contribute to the vulnerability of the PTA variant, such as persistence of embryonic vessels that may be structurally abnormal. Also, the hemodynamic change caused by persistent embryonic vessels may increase vascular stress, thus exaggerating vessel fragility. Furthermore, this PTA variant had a tortuous course and was embedded in or adhered to the cavernous sinus proximally. During head injury, a sudden stretching force transmitted from the distal branch to the restricted, fragile proximal trunk could tear the vessel and create CCF.

This PTA variant is the only vessel supplying the left AICA territory. Occlusion of this vessel would likely lead to cerebellar and/or brainstem infarct. The goal of endovascular treatment is to occlude the fistula while preserving the PTA variant. Detachable balloon occlusion has been the standard for endovascular treatment of traumatic CCF.

In this case, we adopted GDC embolization

with a venous approach due to concern regarding difficulty performing transarterial detachable balloon embolization. To prevent the torn PTA variant from further manipulation and to determine the intraluminal flow without an indwelling microcatheter, we chose to avoid transarterial GDC embolization, although it may have been feasible.

The advantages of using GDCs include thrombogenicity, more controllable delivery, radiopacity, and biocompatibility. The coils can easily be manipulated into a proper position before electrolytic detachment. In case of migration or unsatisfactory positioning, the coil can be withdrawn and repositioned. Furthermore, since GDCs are soft and flexible they can adapt to the shape of the fistula.

### Conclusions

Though rarely encountered, the PTA variant is associated with increased frequency of aneurysms and vulnerability to vascular injury. When this vessel itself is involved in an aneurysm or a CCF, it is important to preserve this vessel during either endovascular intervention or surgery because inadvertent occlusion may lead to cerebellar and/or brainstem infarct.

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